

**Advanced Numerical Computations 2009**  
**Matrix manipulations**

1. Use matlab instructions to generate the following vectors or matrices

(a)  $X = \begin{pmatrix} 2 & 0 & \dots & 0 \\ 0 & 4 & \dots & 0 \\ \vdots & \vdots & \dots & \vdots \\ 0 & 0 & \dots & 200 \end{pmatrix}$

(b)  $X = \begin{pmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \end{pmatrix}$

(c)  $X = (1\ 2\ 3\ \dots\ 1000)$

(d)  $X = (0\ 0.02\ 0.04\ \dots\ 0.98\ 1)$

(e)  $X = (-1000\ -995\ -990\ \dots\ 990\ 995\ 1000)$

(f)  $X$  is a  $100 \times 100$  matrix. Each of its row equals  $(1\ 2\ 3\ \dots\ 100)$

(g)  $X$  is a  $1 \times 100$  row vector. The first fifty elements of  $X$  are ones and the others are zeros.

(h)  $X$  is a  $10 \times 20$  matrix. All of its elements are a sample from a uniform distribution that ranges from 0 to +5.

(i)  $X$  is a  $10 \times 20$  matrix. All of its elements are a sample from a standard normal distribution.

(j) Let  $X = \begin{pmatrix} 1 & 1 & \dots & 1 \\ 2 & 2 & \dots & 2 \\ \vdots & \vdots & \vdots & \vdots \\ 10 & 10 & \dots & 10 \end{pmatrix}$ . Use 'repmat' to generate a matrix that concatenates ten copies of  $X$  in one row.

(k) Generate a matrix that is composed of  $10 \times 10$  blocks, where each block is identical to  $X = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix}$ .

2. Describe results of the following instructions or give required matlab instructions.

(a) `diag(1:3:9)`

(b) `diag(1:2:7,-1) + diag(1:2:9) + diag(1:2:7,1)`

(c) `a=2;b=3;a=b;b=a; a+b`

(d) Let  $a = 2$  and  $b = 3$ . Swap  $a$  and  $b$  such that  $a = 3$  and  $b = 2$

(e) `x=1:5; y=5:-1:1; z= x>y`

(f) `f=inline('x.^2 - 1');f([1 2])`

(g) `f=inline('x.^2 + 2 * x + 2');f([1 2])`

(h) `a = [1 2 3 4 5 6];reshape(a,2,3)`

(i) `a = [1 2 3 4 5 6]';reshape(a,2,3)`

3. Use matlab instructions to plot the following figures

(a) Four points,  $(-1\ 1)$ ,  $(1\ 1)$ ,  $(1\ -1)$  and  $(-1\ -1)$ , and lines that connect any two points.

(b) 400 points that are uniformly distributed within  $[-2\ 2] \times [-2\ 2]$ .

(c) A curve for function  $f(x) = \cos(x) + \sin(x)$  for  $x \in [-2\pi\ 2\pi]$ .

(d) A figure that contains four subplots, respectively plotting  $\cos(x)$ ,  $\cos(2x)$ ,  $\cos(3x)$ ,  $\cos(4x)$  for  $x \in [-2\pi\ 2\pi]$ .

4. Use matlab instructions to plot points defined by  $(n, x_n)$  with  $n$  runs from 1 to 10, where  $x_n = \sum_{i=1}^n i^3$ .